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Chapter-1: Rational Numbers

Exercise 1.1 (Page 14 of Grade 8 NCERT)

Q1. Using appropriate properties find:

(*i*) $\frac{-2}{3}\times\frac{3}{5}+\frac{5}{2}-\frac{3}{5}\times\frac{1}{6}$ (*ii*) $\frac{2}{5}\times\left(\frac{-3}{7}\right)-\frac{1}{6}\times\frac{3}{2}+\frac{1}{14}\times\frac{2}{5}$

Difficulty Level: Easy

What is the known/given?
Rational numbers with addition subtraction and multiplication.

What is the unknown?
Result of addition, subtraction and multiplication of rational numbers.

Reasoning:
By using commutativity of multiplication and addition getting the answer.

Solution (i):

$$=\frac{-2}{3}\times\frac{3}{5}+\frac{5}{2}-\frac{3}{5}\times\frac{1}{6}$$

$$=\frac{3}{5}\times\frac{-2}{3}+\frac{5}{2}-\frac{3}{5}\times\frac{1}{6}$$ [By commutativity of multiplication]

$$=\frac{3}{5}\times\frac{-2}{3}-\frac{3}{5}\times\frac{1}{6}+\frac{5}{2}$$ [Commutativity of addition]

[Rearranging to take a common]

$$=\frac{3}{5}\times\left(\frac{-2}{3}-\frac{1}{6}\right)+\frac{5}{2}$$

$$=\frac{3}{5}\times\left(\frac{-4-1}{6}\right)+\frac{5}{2}$$

$$=\frac{3}{5}\times\frac{-5}{6}+\frac{5}{2}$$

$$=-\frac{1}{2}+\frac{5}{2}$$

$$=\frac{-1+5}{2}$$

$$=\frac{4}{2}=2$$

Answer (i): 2

Solution (ii):

$$=\frac{2}{5}\times\left(\frac{-3}{7}\right)-\frac{1}{6}\times\frac{3}{2}+\frac{1}{14}\times\frac{2}{5}$$

Rearranging

$$=\frac{2}{5}\times\left(\frac{-3}{7}\right)+\frac{2}{5}\times\frac{1}{14}-\frac{1}{6}\times\frac{3}{2}$$

Taking $\frac{2}{5}$ common

$$=\frac{2}{5}\times\left[\left(\frac{-3}{7}\right)+\frac{1}{14}\right]-\frac{1}{6}\times\frac{3}{2}$$ [by distributivity]

$$=\frac{2}{5}\times\left(\frac{-3\times2+1}{14}\right)-\frac{1}{6}\times\frac{3}{2}$$

$$=\frac{2}{5}\times\left(\frac{-6+1}{14}\right)-\frac{1}{4}$$

$$=\frac{2}{5}\times\frac{-5}{14}-\frac{1}{4}$$

$$=\frac{-1}{7}-\frac{1}{4}$$

$$=\frac{(-1\times4)}{(7\times4)}-\frac{(1\times7)}{(4\times7)}$$

$$=-\frac{4}{28}-\frac{7}{28}$$

$$=\frac{-4-7}{28}$$

$$=-\frac{11}{28}$$

Answer (ii): $=-\frac{11}{28}$

Q2. Write the additive inverse of each of the following

(i) $\frac{2}{8}$ (ii) $\frac{-5}{9}$ (iii) $\frac{-6}{-5}$ (iv) $\frac{2}{-9}$ (v) $\frac{19}{-6}$

Difficulty Level: Easy

What is the known/given?
Rational numbers

What is the unknown?
Additive inverse.

Reasoning:
The negative of a rational number is called additive inverse.

Solution:

(i) $\frac{2}{8}$

Additive inverse of $\frac{2}{8}$ is $-\left(\frac{2}{8}\right)=-\frac{2}{8}$

(ii) $\frac{-5}{9}$

Additive inverse of $\frac{-5}{9}$ is $-\left(\frac{-5}{9}\right)=\frac{5}{9}$

(iii) $\frac{-6}{-5}$

The rational number is $\frac{-6}{-5}=\frac{6}{5}$

Additive inverse of $\frac{-6}{-5}$ is $-\left(\frac{6}{5}\right)=-\frac{6}{5}$

(iii) $\frac{2}{-9}$

Additive inverse of $\frac{2}{-9}$ is $-\left(\frac{2}{-9}\right)=\frac{2}{9}$

(v) $\frac{19}{-6}$

Additive inverse of $\frac{19}{-6}$ is $-\left(\frac{19}{-6}\right)=\frac{19}{6}$

Q3. Verify that $-(-x)=x$ *for*

(i) $x=\frac{11}{15}$ (ii) $x=-\frac{13}{7}$

Difficulty Level: Easy

What is the known/given?
Rational number.

What is the unknown?
The negative of the negative of a rational number.

Reasoning:
The negative of the negative of a rational number is that rational number of Self.

Solution:

(i) $x = \frac{11}{15}$

$$-(-x) = -\left(-\frac{11}{15}\right)$$
$$= \frac{11}{15}$$
$$= x$$

Proved.

(ii) $x = -\frac{13}{17}$

$$-(-x) = -\left[-\left(-\frac{13}{17}\right)\right]$$
$$= -\left[\frac{13}{17}\right]$$
$$= -\frac{13}{17}$$
$$= x$$

Proved.

Q4. Find the multiplicative inverse of the following.

(i) -13 (ii) $\frac{-13}{19}$ (iii) $\frac{1}{5}$ (iv) $\frac{-5}{8} \times \frac{-3}{7}$ (v) $-1 \times \frac{-2}{5}$ (vi) -1

Difficulty Level: Medium

What is the known/given?
Rational number

What is the unknown?
The multiplicative inverse.

Reasoning:
The reciprocal of the given rational number is the multiplicative inverse. [the product of the rational number and its multiplicative inverse is 1]

Solution:

(i) The Multiplicative inverse of -13 is $\frac{-1}{13}$

$$\left[-13\times\frac{-1}{13}=1\right]$$

(ii) The Multiplicative inverse of $\frac{-13}{19}$ is $\frac{19}{-13}$

$$\left[\frac{-13}{19}\times\frac{19}{-13}=1\right]$$

(iii) The Multiplicative inverse of $\frac{1}{5}$ is $\frac{5}{1}$

$$\left[\frac{1}{5}\times\frac{5}{1}=1\right]$$

(iv) $\frac{-5}{8}\times\frac{-3}{7}=\frac{15}{56}$

The Multiplicative inverse of $\frac{15}{56}$ is $\frac{56}{15}$

$$\left[\frac{15}{56}\times\frac{56}{15}=1\right]$$

$(v)\ -1\times\frac{-2}{5}$

This can be simplified as:

$$-1\times\frac{-2}{5}=\frac{(-1)\times(-2)}{5}$$

$$=\frac{2}{5}$$

The multiplicative inverse of $\frac{2}{5}$ is $\frac{5}{2}$

(v) The multiplicative inverse of -1 is -1.

$$(-1)\times(-1)=1$$

Q5. Name the property under multiplication used in each of the following:

(i) $\frac{-4}{5}\times 1 = 1\times\frac{-4}{5} = \frac{-4}{5}$ (ii) $\frac{-13}{17}\times\frac{-2}{7} = \frac{-2}{7}\times\frac{-13}{17}$ (iii) $\frac{-19}{29}\times\frac{29}{-19} = 1$

Difficulty Level: Easy

What is the known/given?
Rational number.

What is the unknown?
Name of the property.

Reasoning:
So, 1 is the multiplicative identity.

Solution:
(i)

$$\frac{-4}{5}\times 1 = 1\times\frac{-4}{5} = \frac{-4}{5}$$

$\therefore$ 1 is the multiplicative identity and here, property of multiplicative identity is used.

(ii) $\frac{-13}{17}\times\frac{-2}{7} = \frac{-2}{7}\times\frac{-13}{17}$

What is the known/given?
Rational numbers.

What is the unknown?
The property name.

Reasoning:
In general, $a\times b = b\times a$ for any two rational numbers. This is called commutativity of multiplication.

Solution:

$$\frac{-13}{17}\times\frac{-2}{7} = \frac{-2}{7}\times\frac{-13}{17}$$

$$[a\times b] = [b\times a]$$

Answer:
Commutativity of multiplication of rational numbers is used here.

(iii) $\frac{-19}{29}\times\frac{29}{-19}=1$

What is the known/given?
Rational numbers.

What is the unknown?
The property name.

Reasoning:

For a rational number $\frac{a}{b}$ the multiplicative inverse is the reciprocal of that number that is $\frac{b}{a}$. So that the product of the rational number and its multiplicative inverse is 1.

$$\frac{-19}{29}\times\frac{29}{-19}=1$$
$$\left[\left(\frac{a}{b}\right)\times\left(\frac{b}{a}\right)\right]=1$$

Answer: Multiplicative Inverse..

Q6. Multiply $\frac{6}{13}$ by the reciprocal of $\frac{-7}{16}$

Difficulty Level: Easy

What is the known/given?
Rational numbers.

What is the unknown?
Product of the rational numbers.

Reasoning:
Reciprocal of a rational number is its multiplicative inverse.

Solution:

$\frac{6}{13}\times$ Reciprocal of $\frac{-7}{16}$ $\quad\left|\text{Reciprocal of } \frac{-7}{16} \text{ is } \frac{16}{-7}\right|$

$$=\frac{6}{13}\times\frac{16}{-7}$$
$$=\frac{6\times16}{13\times(-7)}$$
$$=\frac{96}{-91}$$

Answer:

$$=\frac{-96}{91}$$

Q7. Tell what property allow you to compute $\frac{1}{3}\times\left(6\times\frac{4}{3}\right)$ as $\left(\frac{1}{3}\times 6\right)\times\frac{4}{3}$

Difficulty Level: Easy

What is the known/given?
Rational numbers.

What is the unknown?
Property.

Reasoning:
Multiplication is associative for rational numbers. For any rational numbers a, b, c

$$a\times(b\times c)=(a\times b)\times c$$

Solution:

$$[a\times(b\times c)=(a\times b)\times c]$$

$$\frac{1}{3}\times\left(6\times\frac{4}{3}\right) \text{ as } \left(\frac{1}{3}\times 6\right)\frac{4}{3}$$

Answer:
Associativity of multiplication of rational numbers is used here.

Q8. Is $\frac{8}{9}$ the multiplicative inverse of $-1\frac{1}{8}$? Why or why not?

Difficulty Level: Medium

What is the known/given?
Rational numbers.

What is the unknown?
Multiplicative or not

Reasoning:
The product of a rational number with its multiplicative inverse is 1.

Solution:

$$-1\frac{1}{8}=-\frac{9}{8}$$

Now: $=\frac{8}{9}\times-\frac{9}{8}=-1\neq 1$

Answer:
So, $\frac{8}{9}$ is not the multiplicative inverse of $-1\frac{1}{8}$.

$\frac{8}{9}$ is not the multiplicative inverse of $-1\frac{1}{8}$ because the product of $\frac{8}{9}$ and $-1\frac{1}{8}$ is -1, and it should be 1 to be a multiplicative inverse.

Q9. Is 0.3 the multiplicative inverse of $3\frac{1}{3}$? Why or why not?

Difficulty Level: Medium

What is the known/given?
Rational number.

What is the unknown?
Multiplicative inverse or not?

Reasoning:
The product of the rational number and its multiplicative inverse is 1.

Solution:

0.3 can be written as $\frac{3}{10}$

Given rational number $3\frac{1}{3}$ can be written as $\frac{10}{3}$

So, $\frac{3}{10}\times\frac{10}{3}=1$

Answer 8:

Yes, 0.3 is the multiplicative inverse of $3\frac{1}{3}$ because their product is 1.

Q10. Write:

(i) The rational number that does not have a reciprocal.
(ii) The rational numbers that are equal to their reciprocals.
(iii) The rational number that is equal to its negative.

(i) Rational number does not have a reciprocal

Answer:
0 (zero) is the rational number which does not have a reciprocal.

(ii) The rational number that is equal to its reciprocals.

Answer:
The rational numbers 1 and (–1) are equal to their own reciprocals.

(iii) The rational number that is equal to its negative.

Answer:
Rational number 0 is equal to its negative.

Q11. Fill in the blanks.

(i) Zero has _____ reciprocal.
(ii) The numbers _____ and _____ are their own reciprocals
(iii) The reciprocal of -5 is _____.
(iv) Reciprocal of $\frac{1}{x}$, where $x \neq 0$ is _____.
(v) The product of two rational numbers is always a _____.
(vi) The reciprocal of a positive rational number is _____.

Answer:

1. Zero has no reciprocal
2. The numbers 1 and (–1) are their own reciprocals.
3. The reciprocal of (–5) is $\frac{1}{-5}$
4. Reciprocal of $\frac{1}{x}$ where $x \neq 0$ is x.
5. The product of two rational numbers is always a rational number.
6. The reciprocal of a positive rational number is positive.

Exercise1.2 [page 20]

Q1. Represent these numbers on the number line.

(i) $\frac{7}{4}$ (ii) $\frac{-5}{6}$

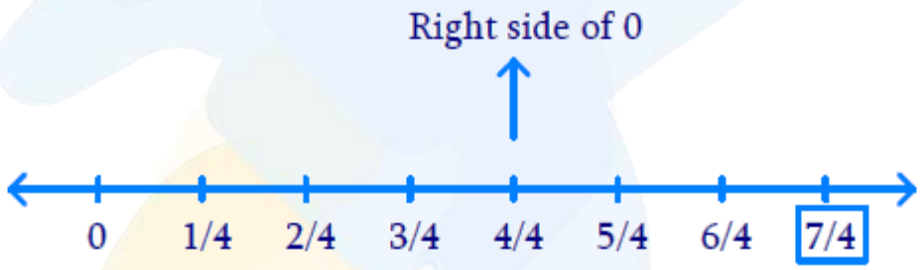
Difficulty level: Medium

Reasoning:
The positive numbers are on the right of 0 and negative numbers are represented on the left of 0 in the number line. The denominator of the rational number indicates the number of equal parts into which the first unit has to be divided whereas the numerator indicates as to how many of these parts are to be taken into consideration.

Solution:

$\frac{7}{4}$ The first unit has to be divided by 4 parts. We make 7 markings of distance $\frac{1}{4}$ Each on the right of 0 and starting from 0. The seventh marking represents $\frac{7}{4}$

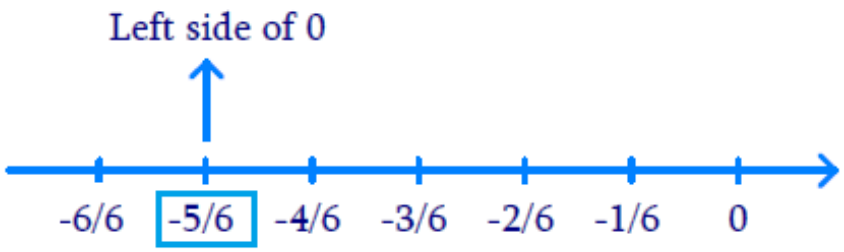
Diagram



(i) $\frac{-5}{6}$ The first unit has to be divided into 6 parts. We make 5 markings of distance $\frac{1}{6}$ each on the left of 0 and starting from 0.

The fifth marking represents $\frac{5}{6}$ left side of 0.

Diagram



Q2. Represent $\frac{-2}{11}, \frac{-5}{11}, \frac{-9}{11}$ on the number line.

Difficulty level: Medium

Reasoning:
The negative numbers are represented on the left of 0 in the number line. The denominator of the rational number indicates the number of equal parts into which the first unit has to be divided whereas the numerator indicates as to how many of these parts are to be taken into consideration.

Solution:

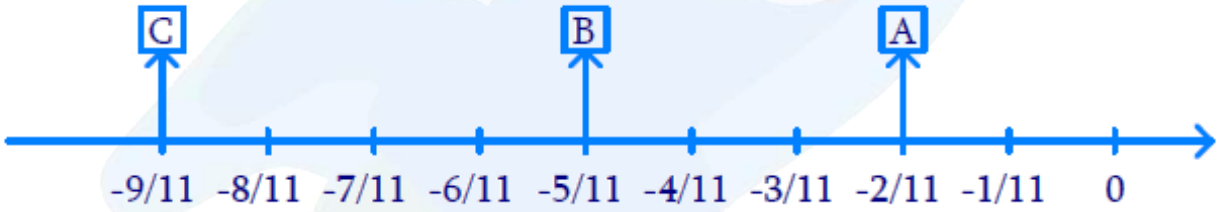
We make 9 marking of distance $\frac{1}{11}$ each on the left of 0 and starting from 0.

The second marking represent $\frac{-2}{11}$ which is represented as A in the line.

The fifth marking represent $\frac{-5}{11}$ representations B in the line.

The ninth marking represent $\frac{-9}{11}$ represented as C in the number line.

Diagram



Q3. Write five rational numbers which are smaller than 2.

Difficulty level: Easy

What is the known/given?
Rational numbers.

What is the unknown?
The rational numbers between given rational numbers.

Reasoning:
We can write infinitely many rational numbers lesser than number 2.

Solution:

Five rational numbers which are smaller than 2 are $1, \frac{1}{2}, 0, -1, \frac{-1}{2}$

Q4. Find ten rational numbers between $\frac{-2}{5}$ and $\frac{1}{2}$

Difficulty level: Medium

What is the known/given?
Rational numbers.

What is the unknown?
The rational numbers between given rational numbers.

Reasoning:
We can find infinitely many rational numbers between any two given rational numbers by taking the mean of the two rational numbers. Another method: We can make the denominator same for the two given rational numbers.

Solution:

$$\frac{-2}{5}=\frac{-2\times 2}{5\times 2}=\frac{-4}{10}$$ [multiplying both numerator and denominator by 2]

$$\frac{1}{2}=\frac{1\times 5}{2\times 5}=\frac{5}{10}$$ [multiplying both numerator and denominator by 5]

[Multiplying both numerators and denominators by the same number]

Now, there are 9 rational numbers between $\frac{-4}{10}$ and $\frac{5}{10}$, but we need 10 numbers. So, we should again multiply both numerator and denominator by 2 in the two rational numbers $\frac{-4}{10}$ and $\frac{5}{10}$

$$\frac{-4\times 2}{10\times 2}=\frac{-8}{20} \text{ and } \frac{5}{10}\times\frac{2}{2}=\frac{10}{20}$$

The ten rational numbers between $\frac{-2}{5}$ and $\frac{1}{2}$ which can be taken as.

$$\frac{-7}{20}, \frac{-6}{20}, \frac{-5}{20}, \frac{-4}{20}, \frac{-3}{20}, \frac{-2}{20}, \frac{1}{20}, 0, \frac{1}{20} \text{ and } \frac{2}{20}.$$

[There are many more such rational numbers.]

Q5. Find five rational numbers between**,**

(i) $\frac{2}{3}$ and $\frac{4}{5}$

(ii) $\frac{-3}{2}$ and $\frac{5}{3}$

(iii) $\frac{1}{4}$ and $\frac{1}{2}$

Difficulty level: Medium

What is the known/given?
Rational numbers.

What is the unknown?
The rational numbers between given rational numbers.

Reasoning:
We can find infinitely many rational numbers between any two given rational numbers by taking the mean of the two rational numbers. Another method: We can make the denominator same for the two given rational numbers.

Solution:

(i) $\frac{2}{3}$ and $\frac{4}{5}$

$\frac{2}{3} = \frac{2\times 20}{3\times 20} = \frac{40}{60}$ [multiplying both numerator and denominator by 20]

$\frac{4}{5} = \frac{4\times 12}{5\times 12} = \frac{48}{60}$ [multiplying both numerator and denominator by 12]

Answer:

The five rational numbers between $\frac{2}{3}$ and $\frac{4}{5}$ that can be taken are:

$$\frac{41}{60}, \frac{42}{60}, \frac{43}{60}, \frac{44}{60}, \frac{45}{60}$$

Solution:

(ii) $\frac{-3}{2}$ and $\frac{5}{3}$

$\frac{-3}{2} = \frac{-3\times 3}{2\times 3} = \frac{-9}{6}$ [multiplying both numerator and denominator by 3]

$\frac{5}{3} = \frac{5\times 2}{2\times 3} = \frac{10}{6}$ [multiplying both numerator denominator by 2]

Answer:

$\therefore$ The five rational numbers between $\frac{-3}{2}$ and $\frac{5}{3}$ that can be taken are:

$$-\frac{8}{6}, -\frac{7}{6}, -1, -\frac{5}{6}, -\frac{4}{6}$$

[There can be more such rational numbers]

(iii) Solution:

(iv) $\frac{1}{4}$ and $\frac{1}{2}$

$\frac{1}{4} = \frac{1\times8}{4\times8} = \frac{8}{32}$ [multiplying both numerator and denominator by 8]

$\frac{1}{2} = \frac{1\times16}{2\times16} = \frac{16}{32}$ [multiplying both numerator and denominator by 16]

Answer:

Thus, five rational numbers between $\frac{1}{2}$ and $\frac{1}{4}$ that can be taken are:

$\frac{9}{32}, \frac{10}{32}, \frac{11}{32}, \frac{12}{32}, \frac{13}{32}$

Q6. Write five rational numbers greater than –2.

Difficulty level: Medium

What is the known/given?
Rational numbers.

What is the unknown?
The rational numbers between given rational numbers.

Reasoning:
We can find infinitely many rational numbers between any two given rational numbers by taking the mean of the two rational numbers. Another method: We can make the denominator same for the two given rational numbers.

Solution:

Some of the five rational numbers greater than – 2 are -1, 0, $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$

[There can be more such rational numbers]

Q7. Find the rational numbers between $\frac{3}{5}$ and $\frac{3}{4}$

Difficulty level: Medium

What is the known/given?
Rational numbers.

What is the unknown?
The rational numbers between given rational numbers.

Reasoning:

We can find infinitely many rational numbers between any two given rational numbers by taking the mean of the two rational numbers. Another method: We can make the denominator same for the two given rational numbers.

Solution:

$$\frac{3}{5}=\frac{3\times32}{5\times32}=\frac{96}{160}$$ [multiplying both numerator and denominator by 32]

$$\frac{3}{4}=\frac{3\times40}{4\times40}=\frac{120}{160}$$ [multiplying both numerator and denominator by 40]

Answer:

Thus, ten rational numbers between $\frac{3}{5}$ and $\frac{3}{4}$ that can be written are:

$$\frac{97}{160}, \frac{98}{160}, \frac{99}{160}, \frac{100}{160}, \frac{101}{160}, \frac{102}{160}, \frac{103}{160}, \frac{104}{160}, \frac{105}{160}, \frac{106}{160}$$

[There can be many more such rational numbers]

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